

WHAT IS CLAIMED IS:

1. A method of simulating the behavior of a user-interactive environment, the method comprising:
  - running a virtual environment (VE) simulation application that (1) graphically depicts a VE, (2)
  - 5 receives input from a user that corresponds to a user interaction with the VE, and (3) provides graphical output to the user that corresponds to a condition of the VE;
  - running a functional simulation application that
  - 10 determines the condition for the VE at least in part based upon the user input;
  - communicating the user input received by the VE simulation application to the functional simulation application via a high level architecture (HLA) protocol;
  - 15 and
  - communicating the condition determined by the functional simulation application to the VE simulation application via the HLA protocol.
2. The method of claim 1 wherein the VE is a three-dimensional VE, and further comprising managing the two communicating steps with a runtime infrastructure (RTI) interface.
3. The method of claim 2 wherein the user input communicating step comprises publishing via an API module at least one HLA object to the functional simulation application, wherein the published HLA object is at least
- 5 in part defined by the received user input.
4. The method of claim 3 wherein the user input communicating step comprises subscribing to the HLA

object published by the API module, and wherein the functional simulation application running step comprises  
5 processing the subscribed HLA object through conditional logic to determine the condition for the VE.

5. The method of claim 4 wherein the condition communicating step comprises:  
publishing, by the functional simulation application, an HLA object that corresponds to the  
5 determined VE condition; and  
subscribing, by the API module, to the HLA object published by the functional simulation application.

6. The method of claim 5 wherein the VE simulation application running step comprises determining the graphical output for the VE based on the subscribed HLA object published by the functional simulation  
5 application.

7. The method of claim 1 wherein the VE is a three-dimensional VE, and wherein the functional simulation application and the VE simulation application are remote from each other and interconnected via a computer  
5 network.

8. The method of claim 7 wherein the computer network is a Local Area Network (LAN).

9. The method of claim 7 wherein the computer network is the Internet.

10. The method of claim 1 wherein the VE is a three-dimensional VE, and further comprising running a plurality of the functional simulation applications.

11. A method comprising:  
interfacing a virtual environment simulation application with a functional simulation application via a runtime infrastructure (RTI) interface that  
5 communicates data between the two simulation applications according to a high level architecture (HLA) protocol.
12. A simulation system comprising:  
a virtual environment (VE) simulator that is configured to (1) graphically depict a VE, (2) receive input from a user that corresponds to a user interaction  
5 with the VE, and (3) provide graphical output to the user that corresponds to a condition of the VE; and  
a functional simulator that is configured to determine the condition for the VE at least in part based upon the user input;  
10 wherein the VE simulator is configured to communicate the user input received by the VE simulation application to the functional simulation application via a high level architecture (HLA) protocol; and  
wherein the functional simulator is configured to  
15 communicate the condition determined by the functional simulation application to the VE simulation application via the HLA protocol.
13. The system of claim 12 wherein the VE is a three-dimensional VE.
14. The system of claim 13 wherein the VE simulator and the functional simulator are configured to communicate with each other via a runtime infrastructure (RTI) interface.

15. The system of claim 14 wherein the VE simulator comprises an API module for communicating with the functional simulator via at least one HLA object that is defined at least in part by the received user input.

16. The system of claim 15 wherein the API module further comprises a library of HLA objects that are defined at least in part by received user input.

17. The system of claim 15 wherein the functional simulator is further configured to subscribe to the HLA object published by the API module, and wherein the functional simulator is further configured to process the  
5 subscribed HLA object through conditional logic to determine the condition for the VE.

18. The system of claim 17 wherein the functional simulator is further configured to publish an HLA object that corresponds to the determined VE condition, and wherein the API module is further configured to subscribe  
5 to the HLA object published by the functional simulation application.

19. The system of claim 18 wherein the VE simulator is further configured to determine the graphical output for the VE based on the subscribed HLA object published by the functional simulation application.

20. The system of claim 13 wherein the functional simulator and the VE simulator are remote from each other and interconnected via a computer network.

21. The system of claim 20 wherein the computer network is a Local Area Network (LAN).

22. The system of claim 20 wherein the computer network is the Internet.

23. The system of claim 12 wherein the VE is a virtual aircraft control panel.

24. An apparatus for interfacing software configured to graphically depict a three-dimensional user-interactive virtual environment (VE) with software configured to functionally simulate an application associated with the  
5 VE, the apparatus comprising:

a library of HLA objects that correspond to a state of the VE that is dependent at least in part on user interaction with the VE; and

a processor configured to (1) publish via RTI  
10 messaging at least one HLA object to the functional simulation software according to the HLA protocol, (2) subscribe via RTI messaging to at least one HLA object published by the functional simulation software according to the HLA protocol, wherein the subscribed HLA object  
15 defines at least in part a subsequent state for the VE, and (3) provide data derived from the subscribed HLA object to the VE software for processing thereby.

25. A computer readable medium for interfacing a virtual environment (VE) simulation application configured to graphically depict a three-dimensional user-interactive VE with an associated functional simulation application,  
5 the computer readable medium comprising:

a library of HLA objects that correspond to a state of the VE that is dependent at least in part on user interaction with the VE;

one or more instructions executable by a computer  
10 for publishing, via RTI messaging, at least one HLA

object to the functional simulation application according to the HLA protocol;

one or more instructions executable by a computer for subscribing, via RTI messaging, to at least one HLA  
15 object published by the functional simulation application according to the HLA protocol, wherein the subscribed HLA object defines at least in part a subsequent state for the VE; and

one or more instructions executable by a computer  
20 for providing data derived from the subscribed HLA object to the VE simulation application for processing thereby.

26. An apparatus for simulating the behavior of a user-interactive environment, the apparatus comprising:

a processor configured with (1) a virtual environment (VE) simulation application for (a)  
5 graphically depicting a VE, (b) receiving input from a user that corresponds to a user interaction with the VE, and (c) providing output to the user corresponding to a condition of the VE, the condition being at least in part dependent upon the user input, (2) a functional  
10 simulation application for determining the condition of the environment at least in part based on the user input, and (3) a runtime infrastructure (RTI) interface for (a) communicating user input received by the virtual environment simulation application to the functional  
15 simulation application via a high level architecture (HLA) protocol and (b) communicating the condition determined by the functional simulation application to the virtual environment simulation application via the HLA protocol.

27. The apparatus of claim 26 wherein the RTI interface comprises an application program interface (API) module

configured to receive user input from the virtual  
environment simulation application and publish the user  
5 input to the functional simulation application.

28. The apparatus of claim 27 further comprising a  
plurality of the functional simulation applications, each  
corresponding to a different aspect of system behavior,  
and wherein the RTI interface is further configured to  
5 manage communications among all of the system  
applications.

29. A virtual environment (VE) simulator for graphically  
depicting a three-dimensional user-interactive  
environment comprising:  
5 a plurality of user-interactive visual objects that  
define at least a part of the graphical appearance of the  
VE;

10 a plurality of HLA objects that are defined at least  
in part by user input received by the visual objects;  
an RTI interface configured to (1) publish the HLA  
objects to a functional simulator according to the HLA  
protocol for processing by the functional simulator to  
determine a subsequent graphical appearance for the VE  
and (2) subscribe to HLA objects published by the  
functional simulator, the subscribed HLA objects  
15 corresponding to the determined subsequent graphical  
appearance for the VE; and  
conditional logic for determining any changes to the  
visual objects as a result of the subscribed graphical